(12) UK Patent Application (19) GB (11) 2 303 574 (13) A

(43) Date of A Publication 26.02.1997

(21) Application No 9615215.2

(22) Date of Filing 19.07.1996

(30) Priority Data
(31) 9515012 (32) 21.07.1995 (33) GB

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(51) INT CL[6]
B29C 35/02 , B29D 23/00 23/24 , F16L 11/08

(52) UK CL (Edition O)
B5A AT12P AT9P A1R214A A1R214G A1R214H A1R314C1A A1R314C1C A1R314C1E A1R314C1S A1R314C2S A1R314C6 A1R429A A1R429X A2A4B A2A4F
F2P PM1 P1A15A P1A16A P1A17 P1A9 P1B7B P1B7D P1B7J P1B7P

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(58) Field of Search
UK CL (Edition O) B5A AB1 AB17 AT12P AT9P , F2P PM1
INT CL[6] B29C 35/02 , B29D 23/00 23/18 23/20 23/24 , F16L 11/08
Online: WPI

(54) **Reinforced hose and method of manufacture thereof**

(57) Flexible reinforced hose is manufactured by applying about a support mandrel (10) at least one layer (12,13)(for 13 - figure 4 (not shown) of plastics material and at least one layer (12,14) of reinforcement material and then subjecting the assembly so formed to a hot moulding process to increase the temperature of the plastics material whereby in the finished product a bond is achieved between component layers in consequence of said hot moulding process.

The hose may be used as a suction hose wherein a helically extending metallic structure is embedded in a layer of plastics material. A helically extending high modulus plastics reinforcing structure may be embedded in a layer of plastic material to form the flexible hose.

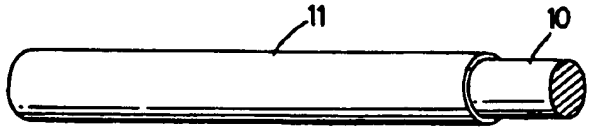

Fig. 2

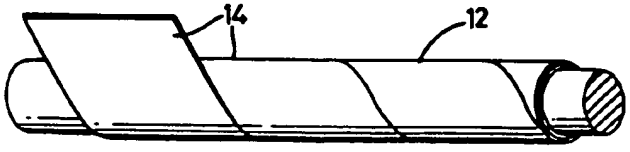

Fig. 3

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IMPROVEMENTS IN AND RELATING TO REINFORCED HOSE

This invention relates to a method for the manufacture of flexible reinforced hose and to flexible reinforced hose which may be made by the method of the invention.

The invention relates in particular, though not exclusively, to so-called industrial type hose having a bore size typically of at least 10 mm, for example in the range 10 mm to 100 mm, and able to transport fluid under pressure.

The invention relates also, but not exclusively, to a hose and method of manufacture of a hose of a rubber/plastics type for example having a spiralled plastics strip liner or cover.

The invention further relates to a hose and method of manufacture of hose which may be of a kind for use as delivery hose or for suction and discharge.

An object of the present invention is to provide a method of hose manufacture which may be undertaken using substantially conventional manufacturing equipment and which is economical to perform.

Another object of the present invention is to provide an improved reinforced hose and an improved method of manufacture of reinforced hose.

According to one aspect of the present invention a method of manufacture of flexible reinforced hose comprises providing a support mandrel, applying about the mandrel at least one layer of plastics material and at least one layer of reinforcement material and then subjecting the assembly so formed to a hot moulding process to increase the temperature of the plastics material whereby in the finished product a bond is achieved between component layers in consequence of said hot moulding process.

The invention envisages that preferably the materials for forming the hose are applied about the support mandrel without the use of solvents and without the use of applied heat.

Optionally the assembly formed about the mandrel may remain supported by the mandrel during the hot moulding process. In an alternative the reinforcement and plastics material are drawn or otherwise removed

from the mandrel, which may be a short length mandrel (e.g. length less than 2 metres, and optionally less than 0.5 metres), before being subjected to the hot moulding process.

The layer of plastics material typically may be a layer of thermoplastics material.

The invention teaches that all components of the hose may be applied cold, by which is meant a temperature below 50°C, optionally below 30°C.

The layer of plastics material is applied in accordance with the invention without any requirement that it should be pre-heated. Typically it may be applied at ambient temperature, or at least at a temperature below 50°C. In the case of a plastics layer of thermoplastics typically it is applied at a temperature below that at which it is mobile. An elevated temperature which significantly reduces the handleability of the material, e g when in strip or sheet form, preferably is avoided.

A suitable plastics material is a thermoplastic plastics material such as polyvinylchloride. Other suitable materials include, for example, polythene, ultra high molecular weight polyethylene, cross-linked polyethylene, and low density polyethylene.

The plastics material may be applied in strip form, either helically, with or without an overlap, or longitudinally and again with or without an overlap.

A carrier of strip material may rotate about a non-rotating mandrel, or a mandrel may rotate and strip material may be supplied from a non-rotating carrier or feed. Similarly, a carrier or feed of strip material may move axially along the length of a mandrel or a carrier or feed for strip material may be fixed axially against movement in the direction of the length of the mandrel and a mandrel may be caused to move axially past said carrier or feed.

Two or more layers of plastics strip material may be provided. One layer may extend helically in a first sense and another may extend helically in an opposite sense. A combination of helically and longitudinally extending strips may be provided.

The reinforcement layer may be formed from reinforcing elements of textile or metallic material which may be applied or arranged to lie helically. Reinforcing elements may be braided, knitted or spirally applied and may be overlapped. The reinforcing elements may each be of a mono filament type or comprise a plurality of filaments such as in a yarn or wire. Suitable reinforcing materials include, for example, cotton, nylon, polyester, and aramid, rayon and metallic materials such as brass-coated steel. Reinforcing elements alternatively may be in the form of a woven fabric such as tyre cord fabric.

The reinforcement layer need not comprise discrete reinforcing elements. It may be formed by a tape or tube of a suitable material such as nylon, e g extruded nylon, or of ultra high molecular weight polyethylene.

The reinforcement layer may be formed concurrent with the layer of plastics material, for example by the use of a strip of plastics material having reinforcing elements secured relative thereto, e g extending longitudinally relative to the length of the strip. Reinforcing elements may be secured relative to a strip of plastics by the use of an adhesive or by embedding the elements in the plastics, e g during extrusion or calendering of plastics to form the strip or soon after extrusion whilst the plastics strip material is still hot and sufficiently soft to allow embedding of the elements. A composite strip of plastics and reinforcing elements may be formed from an assembly of two superimposed layers of strip material having reinforcing elements sandwiched therebetween.

To assist in stabilizing the relative positions of neighbouring elements of reinforcing material, especially discrete non-woven elements such as yarns, the reinforcing elements may be interconnected by a flexible polymeric membrane which in effect may form a web between neighbouring reinforcing elements. The membrane may be employed to stabilise the reinforcing elements either during application about a mandrel and/or in the assembled arrangement prior to the hot moulding process. The membrane may be of rubber or plastics. It may have a thickness less than 1.0 mm, e.g. less than 0.4 mm.

The method may comprise forming a lining layer about the mandrel prior to forming the layers of plastics and reinforcement materials.

The lining layer may be of a vulcanisable material such as rubber or a cross linkable plastic at least in part vulcanised by the hot moulding process step of the invention. Optionally layers of pre-cross linked thermoplastic material may be incorporated in the hose.

The hose assembly may comprise outwards of layers of plastics material and reinforcing material a constraining layer which co-operates with the support mandrel to cause consolidation of the underlying layers during said hot moulding process. The constraining layer may be a temporary layer which is removed after the hot moulding process or it may remain as a part of the finished hose; it may serve as an outer cover layer. The constraining layer may be of a type which shrinks with increase of temperature. It is taught that preferably the increase of temperature will reduce the viscosity of the plastics material.

The invention teaches that bonding together of layers of non-vulcanising material may be achieved by use of a hot moulding process which is performed after assembly of components, preferably all components, of a hose in a non-bonded condition around a mandrel.

The time duration and temperature of the hot moulding process is selected to be sufficient to soften the plastics material to achieve a bond between component layers in the finished hose. It may achieve a bond between all of the component layers. The time duration and temperature preferably is such that plastics material does not extrude through any surrounding layers such as a constraining layer.

The hot moulding process may comprise application of heat, and optionally also external pressure, to the external surface of the assembly of layers for forming the finished hose. Heating may be provided by the use of external heaters, such as radiant heaters, or an autoclave.

The invention envisages that in one embodiment optionally the method may comprise forming about the mandrel a lining layer of extruded material which is still warm from an extruder, and the thermal energy of that

layer may be utilised in part to perform the hot moulding process.

The method may use a solid or tubular mandrel. It may be of a metal such as steel, or of plastics. The mandrel may be of a long length type having a length of at least three (3) metres, typically a length of at least forty (40) metres. Alternatively it may be of a short length as aforedescribed.

The invention also provides a hose made by the method of the invention.

The invention further provides a reinforced hose for use as a suction hose and comprising a layer of plastics material, such as a thermoplastic plastics material having embedded therein a helically extending metallic reinforcing structure. The reinforcing structure may be of a steel wire and be relatively stiff as compared with the body of the hose whereby it provides the hose with resistance to collapse when the pressure external of the hose exceeds that in the bore of the hose.

A suitable plastics material is polyvinylchloride (pvc).

Said suction hose may be manufactured by the method of the present invention.

The suction hose alternatively may have embedded in the plastics layer a metallic reinforcement, which may be a woven wire reinforcement, to provide resistance to pressure arising in the bore of the hose, and a helix of plastics material, such as pvc to provide resistance to collapse.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawings in which:-

Figure 1 is a transverse section of a composite plastics and reinforcement strip for use in manufacture of a hose;

Figure 2 shows in perspective a part-formed hose assembly at a first stage;

Figure 3 is a perspective view showing a part-formed hose assembly at a second stage;

Figure 4 is a perspective of part of a part-formed hose at a third

stage of manufacture, and

Figure 5 is a side view of part of a suction hose, half in longitudinal section, in accordance with another embodiment of the invention.

A delivery type industrial hose having a one inch bore is manufactured by extruding a rubber lining layer 11 about a mandrel 10. Two composite hose body/reinforcement layers 12,13 are then formed around the lining layer 11 by the helical winding of strip material 14 as shown in transverse section in Figure 1. The strip material comprises a layer 15 of pvc to one surface of which a plurality of rayon reinforcing cords 16 have been applied, to extend longitudinally in the direction of the length of the strip. The rayon cords have been caused to embed in the plastics material 15 by passing the cords and strip between a pair of rollers that apply a light consolidating pressure to embed the cords into the plastics before it has cooled.

Particularly to assist handleability no measures are taken to retain any component in a warm condition prior to subsequent manufacture of the hose. Thus, utilising the composite strips 14 of plastics material and reinforcing elements at ambient temperature, one hose layer 12 is formed by helically winding a first strip in a first sense (see Figure 3), and that is then surrounded by a second layer 13 formed by winding a second strip 14 in an opposite sense, as shown in Figure 4.

The hose assembly so formed is then surrounded by a helically wound woven nylon wrapping tape which serves as a constraining layer. Subsequently the hose assembly so formed and supported by the mandrel 10 is placed in an autoclave and subjected to a temperature of approximately 150°C for 35 minutes.

The temperature and duration of time in the autoclave are selected such that the components of the hose become bonded together in consequence of softening of the plastics material, but without the plastics material softening such that the integrity and dimensional stability of the structure is adversely affected.

Subsequently the heated hose assembly is allowed to cool and the constraining wrapper is removed.

For the manufacture of a suction/delivery hose having a four inch bore a lining (21) (see Figure 5) is formed by spirally applying a strip of pvc onto a hollow steel support mandrel.

A layer of reinforcement strip (22) comprising polyester yarns longitudinally embedded in pvc, is spirally applied over the hose lining.

A steel wire (23) of a relatively stiff type known per se for use in the manufacture of suction type hose, is then applied to form a helix over the first reinforcement layer.

A second reinforcement layer (24) of material the same as first layer (22) is spirally applied over the wire helix. A hose outer cover (25) of pvc in strip form is applied spirally.

The hose assembly so formed is then surrounded by a helically wound nylon wrapping strip to serve as a constraining layer.

Subsequently the hose assembly so formed and supported is subjected in a steam autoclave to heating for 35 minutes at approximately 150°C.

Subsequently the heat-moulded hose assembly is allowed to cool, the constraining wrapper is removed and the hose is then removed from the mandrel.

The hose may have an outer shape which is corrugated or which is smooth.

CLAIMS:

1. Method of manufacture of flexible reinforced hose comprising providing a support mandrel, applying about the mandrel at least one layer of plastics material and at least one layer of reinforcement material and then subjecting the assembly so formed to a hot moulding process to increase the temperature of the plastics material whereby in the finished product a bond is achieved between component layers in consequence of said hot moulding process.

2. Method according to claim 1 wherein the plastics material is a thermoplastic plastics material such as polyvinylchloride.

3. Method according to claim 1 or claim 2 wherein the materials for forming the hose are applied about the support mandrel without the use of solvents and without the use of applied heat.

4. Method according to any one of the preceding claims wherein the plastics material is applied in strip form.

5. Method according to claim 4 wherein the plastics strip material is applied helically.

6. Method according to claim 4 wherein the plastics strip material is applied longitudinally.

7. Method according to any one of claims 4 to 6 wherein the strip of plastics material is formed by calendering.

8. Method according to any one of claims 4 to 7 wherein the reinforcement layer is formed concurrent with the layer of plastics material by the use of a strip of plastics material having reinforcing elements secured relative thereto.

9. Method according to claim 8 wherein the reinforcing elements are embedded in the plastics material of the strip.

10. Method according to any one of claims 7 to 9 wherein reinforcing material is embedded in the strip of plastics material during calendering.

11. A method according to any one of claims 1 to 7 wherein the reinforcement material comprises a plurality of reinforcing elements interconnected by a flexible membrane for application about the mandrel.

12. A method according to claim 11 wherein use is made of a membrane having a thickness less than 1.0 mm.

13. Method according to any one of the preceding claims and comprising forming a lining layer, e g a lining layer of vulcanisable material, about the mandrel prior to forming the layers of plastics and reinforcement materials.

14. Method according to any one of the preceding claims and comprising providing outwards of thick layers of plastics and reinforcing materials a constraining layer which co-operates with the support mandrel to cause consolidation of the underlying hose layers during said hot moulding process.

15. Method according to any one of the preceding claims wherein the hot moulding process comprises the application of heat and pressure.

16. Method according to any one of the preceding claims wherein the hot moulding process comprises increasing the temperature of at least part of said plastics material and maintaining said material at an increased temperature and for a period of time sufficient for moulding and fusion of the component layers of the hose.

17. Method according to any one of the preceding claims wherein the components of the finished product are assembled without the use of adhesives.

18. Method according to any one of the preceding claims wherein the assembly formed about the mandrel remains supported by the mandrel during the hot moulding process.

19. Method according to any one of claims 1 to 17 wherein the reinforcement and plastics materials are removed from the mandrel prior to being subjected to the hot moulding process.

20. Method according to claim 19 wherein the mandrel has a length of less than two metres.

21. Method for manufacture of a hose according to claim 1 and substantially as hereinbefore described.

22. A flexible reinforced hose when manufactured by a method according to any one of the preceding claims.

23. A flexible reinforced hose for use as a suction hose and comprising a layer of plastics material having embedded therein a helically extending metallic reinforcing structure.

24. A reinforced hose according to claim 21 wherein the reinforcing element is a steel wire which provides the hose with resistance to collapse when the pressure external of the hose exceeds that in the bore of the hose.

25. A reinforced hose according to claim 21 or claim 22 wherein the metallic reinforcing element is a woven wire reinforcement adapted to provide resistance to pressure arising in the bore of the hose.

26. A reinforced hose according to claim 25 wherein the plastics layer additionally has embedded therein a wire helix to provide resistance to collapse when the pressure external of the hose exceeds that in the bore of the hose.

27. A flexible reinforced hose for use as a suction hose and comprising a layer of plastics material having embedded therein a helically extending high modulus plastics reinforcing structure.

28. A reinforced hose according to claim 27 wherein the reinforcing element is a high modulus plastic which provides the hose with resistance to collapse when the pressure external of the hose exceeds that in the bore of the hose.

29. A reinforced hose according to claim 27 or claim 28 and comprising a reinforcing element which is a textile material adapted to provide resistance to pressure arising in the bore of the hose.

30. A reinforced hose according to claim 29 wherein the plastics layer additionally has embedded therein a wire helix to provide resistance to collapse when the pressure external to the hose exceeds that in the bore of the hose.

31. A reinforced hose according to claim 30 wherein the plastics layer additionally has embedded therein a high modulus plastic helix to provide resistance to collapse when the pressure external of the hose exceeds that in the bore of the hose.

32. A reinforced hose according to claim 24 or claim 27 and substantially as hereinbefore described.

The Patent Office

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Application No:	GB 9615215.2	**Examiner:**	Monty Siddique
Claims searched:	1-22	**Date of search:**	28 August 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B5A (AB11, AB17, AT12P, AT9P); F2P (PM1)

Int Cl (Ed.6): B29C 35/02; B29D 23/00 23/18 23/20 23/24; F16L 11/08

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1558783	(AUTOMATION...) page 1 lines 12-16, 26-45, 55-75;page 3 lines 81-88	1 at least
X	GB 1384545	(DUNLOP) page 1 lines 9-22, 30-50, 56-66; page 2 lines 56-62; claims 1,4 etc.	1 at least
X	GB 1321223	(CREATORS) bonding between polymer and reinforcing layers by hot moulding is known	1 at least
X	GB 1234465	(WAVIN) plastics layer 5, reinforcing layer 4, mandrel 1 etc; hot moulding to bond	1 at least
A	GB 0722612	(BRISTOL...)	1
X	US 4258755	(BANDAG...) column 2 line 40-column 3 line 48 etc.	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

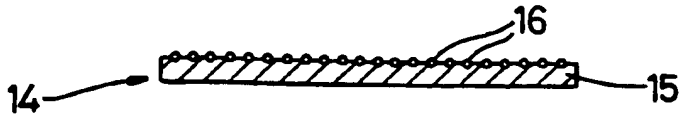

Fig. 1

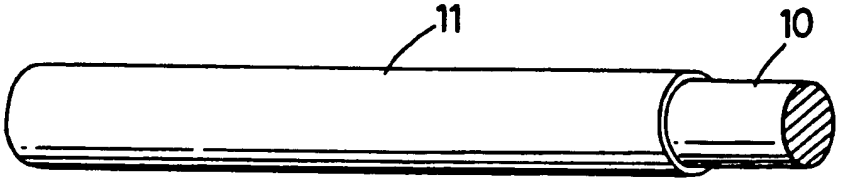

Fig. 2

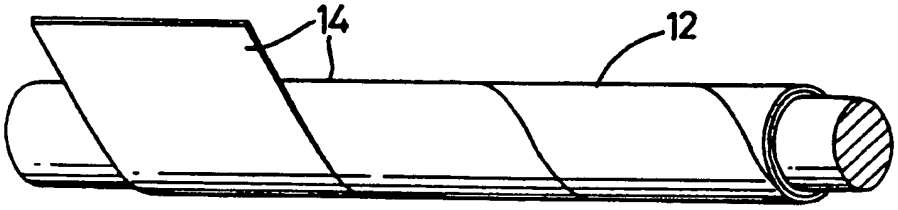

Fig. 3

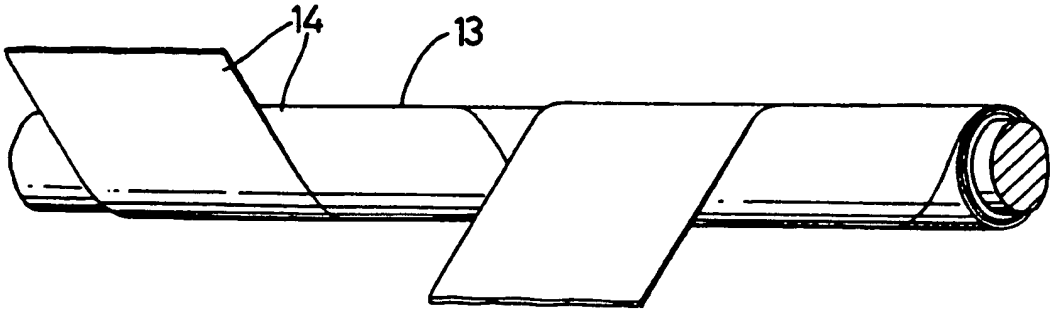

Fig. 4

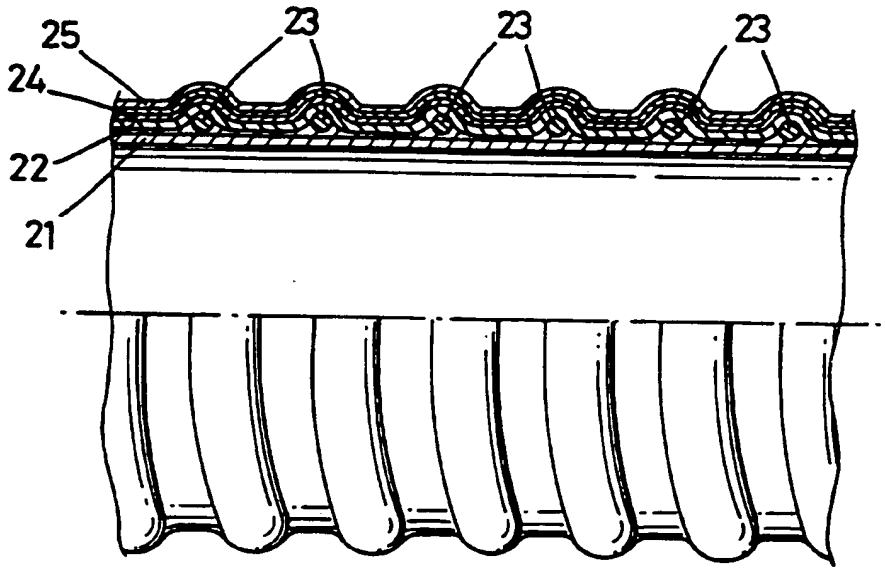

Fig. 5

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